19-0299; Rev. 6; 6/07

Precision, 8-Channel/Dual 4-Channel, Low-Voltage, CMOS Analog Multiplexers

General Description

The MAX398/MAX399 precision, monolithic, CMOS analog multiplexers (muxes) offer low on-resistance (less than 100Ω), which is matched to within 6Ω between channels and remains flat over the specified analog signal range (11Ω max). They also offer low leakage over temperature (NO off-leakage current less than 2.5nA at +85°C) and fast switching speeds (transition time less than 250ns). The MAX398 is an 8-channel device, and the MAX399 is a dual 4-channel device.

The MAX398/MAX399 are fabricated with Maxim's low-voltage silicon-gate process. Design improvements yield extremely low charge injection (less than 5pC) and guarantee electrostatic discharge protection (ESD) greater than 2000V.

These muxes operate with a single +3V to +15V supply or bipolar ±3V to ±8V supplies, while retaining CMOS-logic input compatibility and fast switching. CMOS inputs provide reduced input loading. The MAX398/MAX399 are pin compatible with the industry-standard DG408, DG409, DG508A, and DG509A.

Applications

Sample-and-Hold Circuits
Automatic Test Equipment
Heads-Up Displays
Guidance and Control Systems
Military Radios
Communications Systems
Battery-Operated Systems
PBX, PABX
Audio Signal Routing
Low-Voltage Data-Acquisition Systems

Features

- ♦ **Pin Compatible with Industry-Standard DG408/DG409/DG508A/DG509A**
- ♦ **Guaranteed On-Resistance Match Between Channels (< 6Ω)**
- ♦ **Low On-Resistance (< 100Ω)**
- ♦ **Guaranteed Flat On-Resistance over Signal Range (< 11Ω)**
- ♦ **Guaranteed Low Charge Injection (< 5pC)**
- ♦ **NO Off-Leakage Current < 1nA at +85°C**
- ♦ **COM Off-Leakage Current < 2.5nA at +85°C**
- ♦ **ESD Protection > 2000V**
- ♦ **+3V to +15V Single-Supply Operation ±3V to ±8V Bipolar-Supply Operation**
- ♦ **Low Power Consumption (< 300µW)**
- ♦ **Rail-to-Rail Signal Handling**
- ♦ **TTL/CMOS-Logic Compatible**

Ordering Information

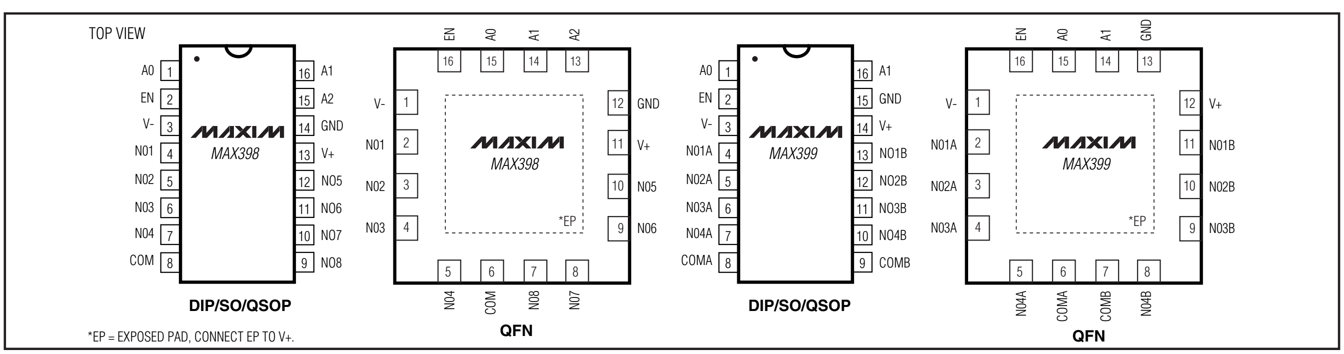
PART	TEMP RANGE	PIN-PACKAGE	PKG CODE
MAX398CGE	0°C to +70°C	16 QFN-EP*	G1655-3
MAX398CEE	0°C to +70°C	16 QSOP	E16-1
MAX398CSE	0°C to +70°C	16 Narrow	S16-1
MAX398CPE	0°C to +70°C	16 Plastic	P16-1
MAX398C/D	0°C to +70°C	Dice**	—
MAX398EGE	-40°C to + 85°C	16 QFN-EP*	G1655-3
MAX398EEE	-40°C to + 85°C	16 QSOP	E16-1
MAX398ESE	-40°C to + 85°C	16 Narrow	S16-1
MAX398EPE	-40°C to + 85°C	16 Plastic	P16-1
MAX398EJE	-40°C to + 85°C	16 CERDIP	J16-1
MAX398MJE	-55°C to +125°C	16 CERDIP	J16-1

Ordering Information continued at end of data sheet.

**EP = Exposed pad.*

***Contact factory for dice specifications.*

Pin Configurations



Precision, 8-Channel/Dual 4-Channel, Low-Voltage, CMOS Analog Multiplexers

ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to GND
- V+ ....-0.3V to +17V
- V- ....+0.3V to -17V
- V+ to V-..-0.3V to +17V

Voltage into Any Terminal (Note 1).........(V- - 2V) to (V+ + 2V) or 30mA (whichever occurs first)
Current into Any Terminal 30mA
Peak Current, Any Terminal
- (pulsed at 1ms, 10% duty cycle max) 40mA

Continuous Power Dissipation (T_A = +70°C)
- QFN (derate 18.5mW/°C above +70°C) 1484mW
- QSOP (derate 8.3mW/°C above +70°C)......................667mW
- Narrow SO (derate 8.7mW/°C above +70°C) 696mW
- Plastic DIP (derate 7.5mW/°C above +70°C)..............470mW
- CERDIP (derate 10.0mW/°C above +70°C.................. 900mW

Operating Temperature Ranges
- MAX39_C_ _ ....0°C to +70°C
- MAX39_E_ _..-40°C to +85°C
- MAX39_MJE ....-55°C to +125°C

Storage Temperature Range ....-65°C to +150°C
Lead Temperature (soldering, 10s) ....+300°C

Note 1: Signals on any terminal exceeding V+ or V- are clamped by internal diodes. Limit forward current to maximum current ratings.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS—Dual Supplies

(V+ = +5V ±10%, V- = -5V ±10%, GND = 0, V_{AH} = V_{ENH} = +2.4V, V_{AL} = V_{ENL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS				MIN	TYP (Note 2)	MAX	UNITS
SWITCH									
Analog Signal Range	V_{COM}, V_{NO}	(Note 3)				V-		V+	V
Channel On-Resistance	R_{ON}	I_{NO} = 1mA, V_{COM} = ±3.5V		T_A = +25°C			60	100	Ω
				T_A = T_{MIN} to T_{MAX}				125	
R_{ON} Matching Between Channels (Note 4)	ΔR_{ON}	I_{NO} = 1mA, V_{COM} = ±3.5V, V+ = 5V, V- = -5V		T_A = +25°C				6	Ω
				T_A = T_{MIN} to T_{MAX}				8	
On-Resistance Flatness (Note 5)	$R_{FLAT(ON)}$	I_{NO} = 1mA, V_{COM} = ±3V, V+ = 5V, V- = -5V		T_A = +25°C				11	Ω
				T_A = T_{MIN} to T_{MAX}				14	
NO Off-Leakage Current (Note 6)	$I_{NO(OFF)}$	V_{NO} = ±4.5V, V_{COM} = ∓4.5V, V+ = 5.5V, V- = -5.5V		T_A = +25°C		-0.1		+0.1	nA
				T_A = T_{MIN} to T_{MAX}	C, E	-1.0		+1.0	
					M	-10		+10	
COM Off-Leakage Current (Note 6)	$I_{COM(OFF)}$	V_{COM} = ±4.5V, V_{NO} = ∓4.5V, V+ = 5.5V, V- = -5.5V	MAX398	T_A = +25°C		-0.2		+0.2	nA
				T_A = T_{MIN} to T_{MAX}	C, E	-2.5		+2.5	
					M	-20		+20	
		V_{COM} = ±4.5V, V_{NO} = ∓4.5V, V+ = 5.5V, V- = -5.5V	MAX399	T_A = +25°C		-0.1		+0.1	
				T_A = T_{MIN} to T_{MAX}	C, E	-1.5		+1.5	
					M	-10		+10	
COM On-Leakage Current (Note 6)	$I_{COM(ON)}$	V_{COM} = ±4.5V, V_{NO} = ±4.5V	MAX398	T_A = +25°C		-0.4		+0.4	nA
				T_A = T_{MIN} to T_{MAX}	C, E	-5		+5	
					M	-40		+40	
			MAX399	T_A = +25°C		-0.2		+0.2	
				T_A = T_{MIN} to T_{MAX}	C, E	-2.5		+2.5	
					M	-20		+20	

ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = +5V ±10%, V- = -5V ±10%, GND = 0, V_{AH} = V_{ENH} = +2.4V, V_{AL} = V_{ENL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
DIGITAL LOGIC INPUT							
Logic-High Input Voltage	V_{AH}, V_{ENH}		T_A = T_{MIN} to T_{MAX}	2.4			V
Logic-Low Input Voltage	V_{AL}, V_{ENL}		T_A = T_{MIN} to T_{MAX}			0.8	V
Input Current with Input-Voltage High	I_{AH}, I_{ENH}	V_A = V_{EN} = 2.4V		-0.1		+0.1	µA
Input Current with Input-Voltage Low	I_{AL}, I_{ENL}	V_A = V_{EN} = 0.8V		-0.1		+0.1	µA
SUPPLY							
Power-Supply Range				±3		±8	V
Positive Supply Current	I+	V_{EN} = V_A = 0V/V+, V+ = 5.5V, V- = -5.5V	T_A = +25°C	-1		+1	µA
Negative Supply Current	I-	V_{EN} = V_A = 0V/V+, V+ = 5.5V, V- = -5.5V	T_A = T_{MIN} to T_{MAX}	-1		+1	µA
Ground Current	I_{GND}	V_{EN} = V_A = 0V/V+, V+ = 5.5V, V- = -5.5V	T_A = +25°C	-1		+1	µA
			T_A = T_{MIN} to T_{MAX}	-1		+1	
DYNAMIC							
Transition Time	t_{TRANS}	Figure 2				150	ns
Break-Before-Make Interval	t_{OPEN}	Figure 4	T_A = +25°C	0	40		ns
Enable Turn-On Time	$t_{ON(EN)}$	Figure 3	T_A = +25°C		60	150	ns
			T_A = T_{MIN} to T_{MAX}			250	
Enable Turn-Off Time	$t_{OFF(EN)}$	Figure 3	T_A = +25°C		40	150	ns
			T_A = T_{MIN} to T_{MAX}			200	
Charge Injection (Note 3)	Q	C_L = 10nF, V_S = 0, R_S = 0Ω	T_A = +25°C		2	5	pC
Off-Isolation (Note 7)		V_{EN} = 0, R_L = 1kΩ, f = 100kHz	T_A = +25°C		-75		dB
Crosstalk Between Channels	V_{CT}	V_{EN} = 2.4V, f = 100kHz, V_{GEN} = 1V_{P-P}, R_L = 1kΩ	T_A = +25°C		-92		dB
Logic Input Capacitance	C_{IN}	f = 1MHz	T_A = +25°C		8		pF
NO Off-Capacitance	$C_{NO(OFF)}$	f = 1MHz, V_{EN} = V_D = 0V	T_A = +25°C		11		pF
COM Off-Capacitance	$C_{COM(OFF)}$	f = 1MHz, V_{EN} = V_D = 0V, MAX398	T_A = +25°C		40		pF
		f = 1MHz, V_{EN} = V_D = 0V, MAX399			20		
COM On-Capacitance	$C_{COM(ON)}$	f = 1MHz, V_{EN} = V_D = 0V, MAX398	T_A = +25°C		54		pF
		f = 1MHz, V_{EN} = V_D = 0V, MAX399			34		

Precision, 8-Channel/Dual 4-Channel, Low-Voltage, CMOS Analog Multiplexers

ELECTRICAL CHARACTERISTICS—Single +5V

(V+ = 5V ±10%, V- = 0, GND = 0, V_{AH} = V_{ENH} = +2.4V, V_{AL} = V_{ENL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS				MIN	TYP (Note 2)	MAX	UNITS
SWITCH									
Analog Signal Range	V_{COM}, V_{NO}	(Note 3)				V-		V+	V
On-Resistance	R_{ON}	I_{NO} = 1mA, V_{COM} = 3.5V, V+ = 4.5V		T_A = +25°C			150	225	Ω
				T_A = T_{MIN} to T_{MAX}				280	
R_{ON} Matching Between Channels (Note 4)	ΔR_{ON}	I_{NO} = 1mA, V_{COM} = 3.5V, V+ = 4.5V		T_A = +25°C				11	Ω
				T_A = T_{MIN} to T_{MAX}				13	
On-Resistance Flatness	R_{FLAT}	I_{NO} = 1mA; V_{COM} = 3V, 2V, 1V; V+ = 5V		T_A = +25°C			10	18	Ω
				T_A = T_{MIN} to T_{MAX}			15	22	
NO Off-Leakage Current (Note 8)	$I_{NO(OFF)}$	V_{NO} = 4.5V, V_{COM} = 0, V+ = 5.5V		T_A = +25°C		-0.1		+0.1	nA
				T_A = T_{MIN} to T_{MAX}	C, E	-1.0		+1.0	
					M	-10		+10	
COM Off-Leakage Current (Note 8)	$I_{COM(OFF)}$	V_{COM} = 4.5V, V_{NO} = 0, V+ = 5.5V	MAX398	T_A = +25°C		-0.2		+0.2	nA
				T_A = T_{MIN} to T_{MAX}	C, E	-2.5		+2.5	
					M	-20		+20	
		V_{COM} = 4.5V, V_{NO} = 0, V+ = 5.5V	MAX399	T_A = +25°C		-0.1		+0.1	
				T_A = T_{MIN} to T_{MAX}	C, E	-1.5		+1.5	
					M	-10		+10	
COM On-Leakage Current (Note 8)	$I_{COM(ON)}$	V_{COM} = 4.5V, V_{NO} = 4.5V, V+ = 5.5V	MAX398	T_A = +25°C		-0.4		+0.4	nA
				T_A = T_{MIN} to T_{MAX}	C, E	-5		+5	
					M	-40		+40	
			MAX399	T_A = +25°C		-0.2		+0.2	
				T_A = T_{MIN} to T_{MAX}	C, E	-2.5		+2.5	
					M	-20		+20	
DIGITAL LOGIC INPUT									
Logic-High Input Voltage	V_{AH}, V_{ENH}			T_A = T_{MIN} to T_{MAX}		2.4			V
Logic-Low Input Voltage	V_{AL}, V_{ENL}			T_A = T_{MIN} to T_{MAX}				0.8	V
Input Current with Input-Voltage High	I_{AH}, I_{ENH}	V_A = V_{EN} = 2.4V				-0.1		+0.1	µA
Input Current with Input-Voltage Low	I_{AL}, I_{ENL}	V_A = 0, V_{EN} = 0.8V				-0.1		+0.1	µA
SUPPLY									
Power-Supply Range						3		15	V
Positive Supply Current	I+	V_{EN} = V_A = 0, V+; V+ = 5.5V; V- = 0				-1.0		+1.0	µA
Negative Supply Current	I-	V_{EN} = V_A = 0V, V+; V+ = 5.5V; V- = 0				-1.0		+1.0	µA
I_{GND} Supply Current	I_{GND}	V_{EN} = V+, 0; V_A = 0; V+ = 5.5V; V- = 0		T_A = +25°C		-1.0		+1.0	µA
				T_A = T_{MIN} to T_{MAX}		-1.0		+1.0	

ELECTRICAL CHARACTERISTICS—Single +5V (continued)

($V+ = 5V \pm 10\%$, $V- = 0$, GND = 0, $V_{AH} = V_{ENH} = +2.4V$, $V_{AL} = V_{ENL} = +0.8V$, $T_A = T_{MIN}$ to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
DYNAMIC							
Transition Time	t_{TRANS}	$V_{NO} = 3V$			90	245	ns
Break-Before-Make Interval	t_{OPEN}		$T_A = +25°C$	10	40		ns
Enable Turn-On Time	$t_{ON(EN)}$		$T_A = +25°C$		90	200	ns
			$T_A = T_{MIN}$ to T_{MAX}			275	
Enable Turn-Off Time	$t_{OFF(EN)}$		$T_A = +25°C$		50	125	ns
			$T_A = T_{MIN}$ to T_{MAX}			200	
Charge Injection (Note 3)	Q	$C_L = 10nF$, $V_S = 0$, $R_S = 0\Omega$	$T_A = +25°C$		1.5	5	pC

ELECTRICAL CHARACTERISTICS—Single +3V

($V+ = 3V \pm 10\%$, $V- = 0$, GND = 0, $V_{AH} = V_{ENH} = +2.4V$, $V_{AL} = V_{ENL} = +0.8V$, $T_A = T_{MIN}$ to T_{MAX}, unless otherwise noted.)

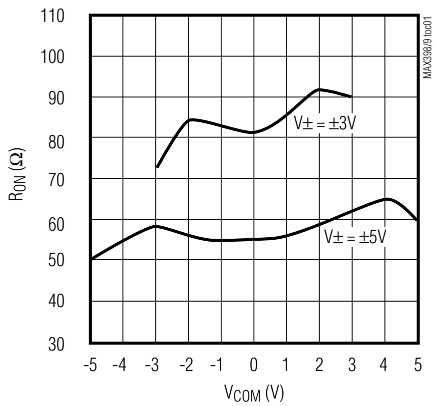
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
SWITCH							
Analog Signal Range	V_{ANALOG}	(Note 3)		V-		V+	V
On-Resistance	R_{ON}	$I_{NO} = 1mA$, $V_{COM} = 1.5V$, $V+ = 3V$	$T_A = +25°C$		230	375	Ω
			$T_A = T_{MIN}$ to T_{MAX}			425	
DYNAMIC							
Transition Time (Note 3)	t_{TRANS}	Figure 2, $V_{IN} = 2.4V$, $V_{N01} = 1.5V$, $V_{N08} = 0$	$T_A = +25°C$		230	575	ns
Enable Turn-On Time (Note 3)	$t_{ON(EN)}$	Figure 3, $V_{INH} = 2.4V$, $V_{INL} = 0$, $V_{N01} = 1.5V$	$T_A = +25°C$		200	500	ns
Enable Turn-Off Time (Note 3)	$t_{OFF(EN)}$	Figure 3, $V_{INH} = 2.4V$, $V_{INL} = 0$, $V_{N01} = 1.5V$	$T_A = +25°C$		75	400	ns
Charge Injection (Note 3)	Q	$C_L = 10nF$, $V_S = 0$, $R_S = 0\Omega$	$T_A = +25°C$		1	5	pC

Note 2: The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.
Note 3: Guaranteed by design.
Note 4: $\Delta R_{ON} = R_{ON}MAX - R_{ON}MIN$.
Note 5: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges, i.e., $V_{NO} = 3V$ to 0 and 0 to -3V.
Note 6: Leakage parameters are 100% tested at maximum rated hot operating temperature, and guaranteed by correlation at +25°C.
Note 7: Worst-case isolation is on channel 4 because of its proximity to the COM pin. Off-isolation = 20log V_{COM} / V_{NO}, V_{COM} = output, V_{NO} = input to off switch.
Note 8: Leakage testing at single supply is guaranteed by correlation testing with dual supplies.

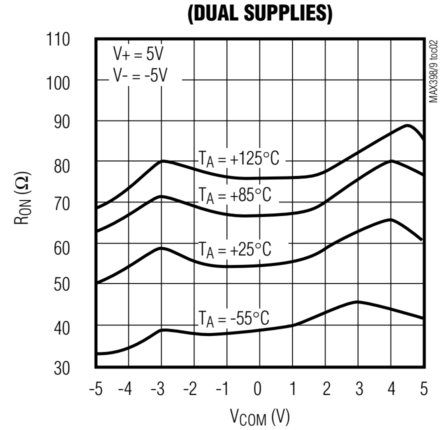
Typical Operating Characteristics

(T_A = +25°C, unless otherwise noted.)

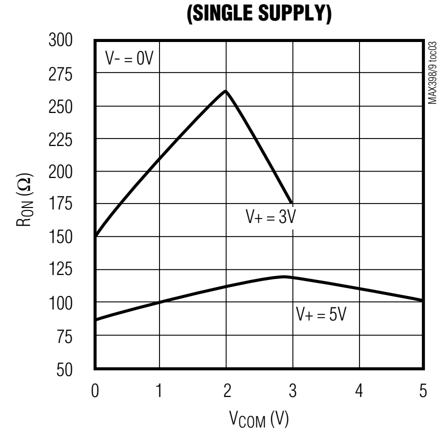
ON-RESISTANCE vs. V_{COM} (DUAL SUPPLIES)



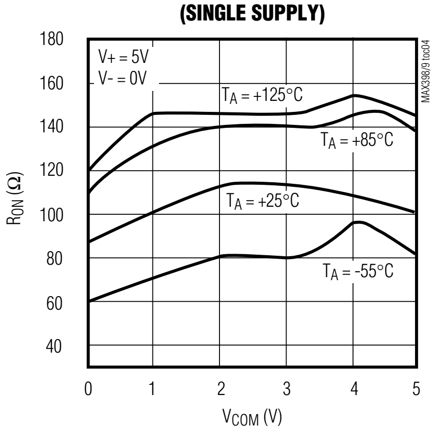
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (DUAL SUPPLIES)



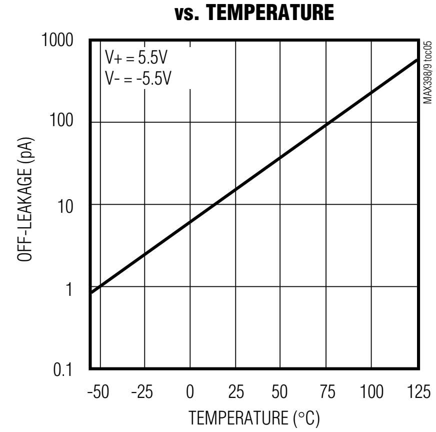
ON-RESISTANCE vs. V_{COM} (SINGLE SUPPLY)



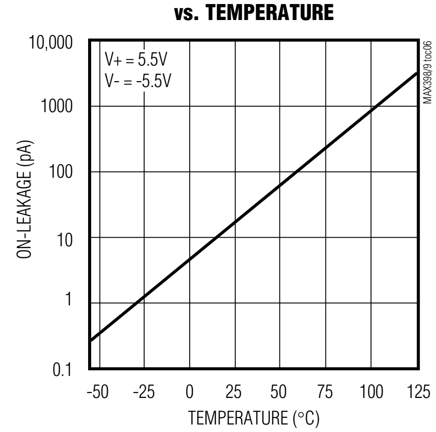
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (SINGLE SUPPLY)



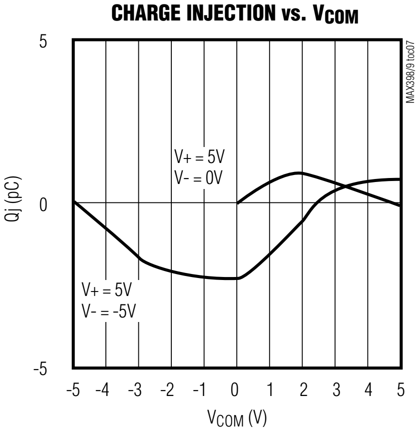
OFF-LEAKAGE vs. TEMPERATURE



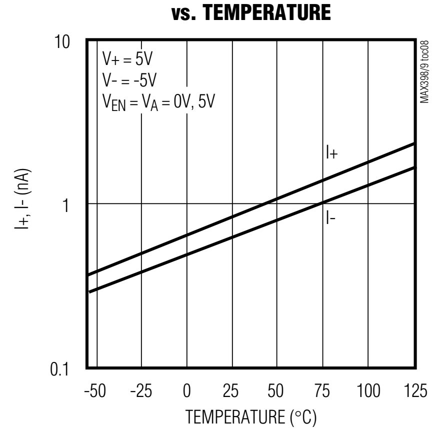
ON-LEAKAGE vs. TEMPERATURE



CHARGE INJECTION vs. V_{COM}



SUPPLY CURRENT vs. TEMPERATURE



Pin Description

PIN				NAME	FUNCTION
MAX398		MAX399			
QSOP/DIP/SO	QFN	QSOP/DIP/SO	QFN		
1, 15, 16	15, 14, 13	—	—	A0, A2, A1	Address Inputs
—	—	1, 16	15, 14	A0, A1	Address Inputs
2	16	2	16	EN	Enable
3	1	3	1	V-	Negative-Supply Voltage Input
4–7	2–5	—	—	N01–N04	Analog Inputs—Bidirectional
—	—	4–7	2–5	N01A–N04A	Analog Inputs—Bidirectional
8	6	—	—	COM	Analog Output—Bidirectional
—	—	8, 9	6, 7	COMA, COMB	Analog Outputs—Bidirectional
9–12	7–10	—	—	N08–N05	Analog Inputs—Bidirectional
–	–	10–13	8–11	N04B–N01B	Analog Inputs—Bidirectional
13	11	14	12	V+	Positive-Supply Voltage Input
14	12	15	13	GND	Ground
—	EP	—	EP	EP	Exposed Pad. Connect to V+.

Applications Information

Operation with Supply Voltages Other than ±5V

Using supply voltages less than ±5V reduces the analog signal range. The MAX398/MAX399 muxes operate with ±3V to ±8V bipolar supplies or with a +3V to +15V single supply. Connect V- to GND when operating with a single supply. Both device types can also operate with unbalanced supplies, such as +10V and -5V. The *Typical Operating Characteristics* graphs show typical on-resistance with ±3V, ±5V, +3V, and +5V supplies. (Switching times increase by a factor of two or more for operation at +5V.)

Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings, because stresses beyond the listed ratings can cause permanent damage to the devices. Always sequence V+ on first, then V-, followed by the logic inputs, NO, or COM. If power-supply sequencing is not possible, add two small signal diodes (D1, D2) in series with supply pins for overvoltage protection (Figure 1). Adding diodes reduces the analog signal range to one diode drop below V+ and one diode drop above V-, but does not affect the devices' low switch resistance and low leakage characteristics. Device operation is unchanged, and the difference between V+ and V- should not exceed 17V. These protection diodes are not recommended when using a single supply.

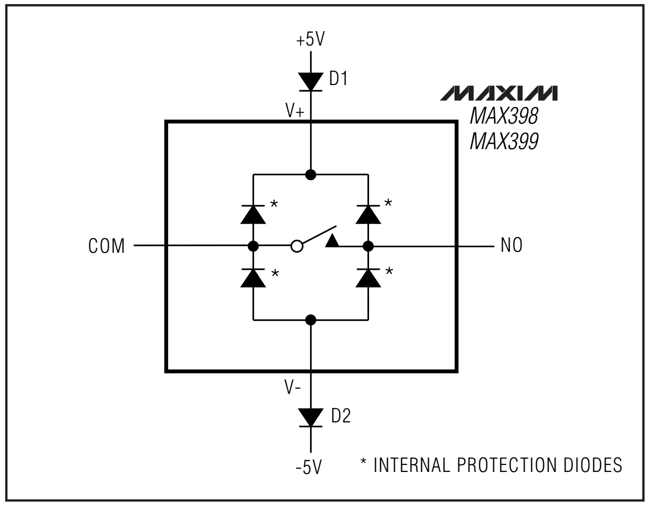


Figure 1. Overvoltage Protection Using External Blocking Diodes

Test Circuits/Timing Diagrams

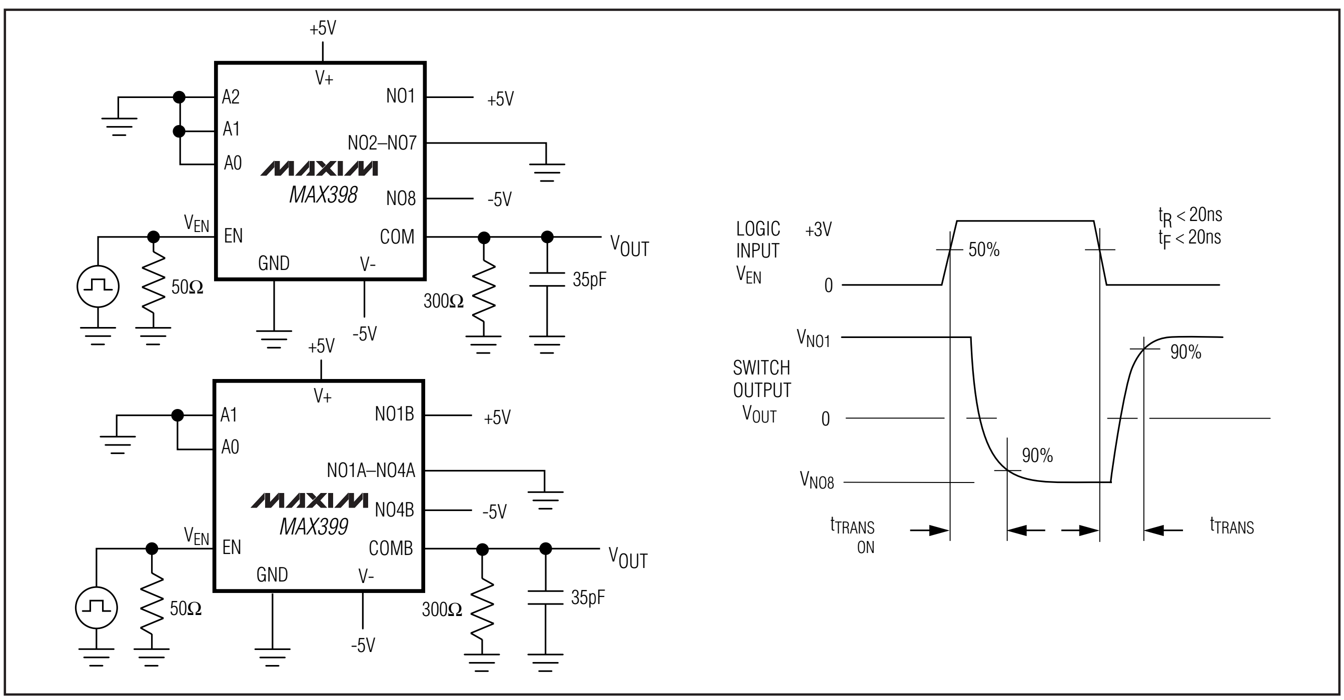


Figure 2. Transition Time

Test Circuits/Timing Diagrams (continued)

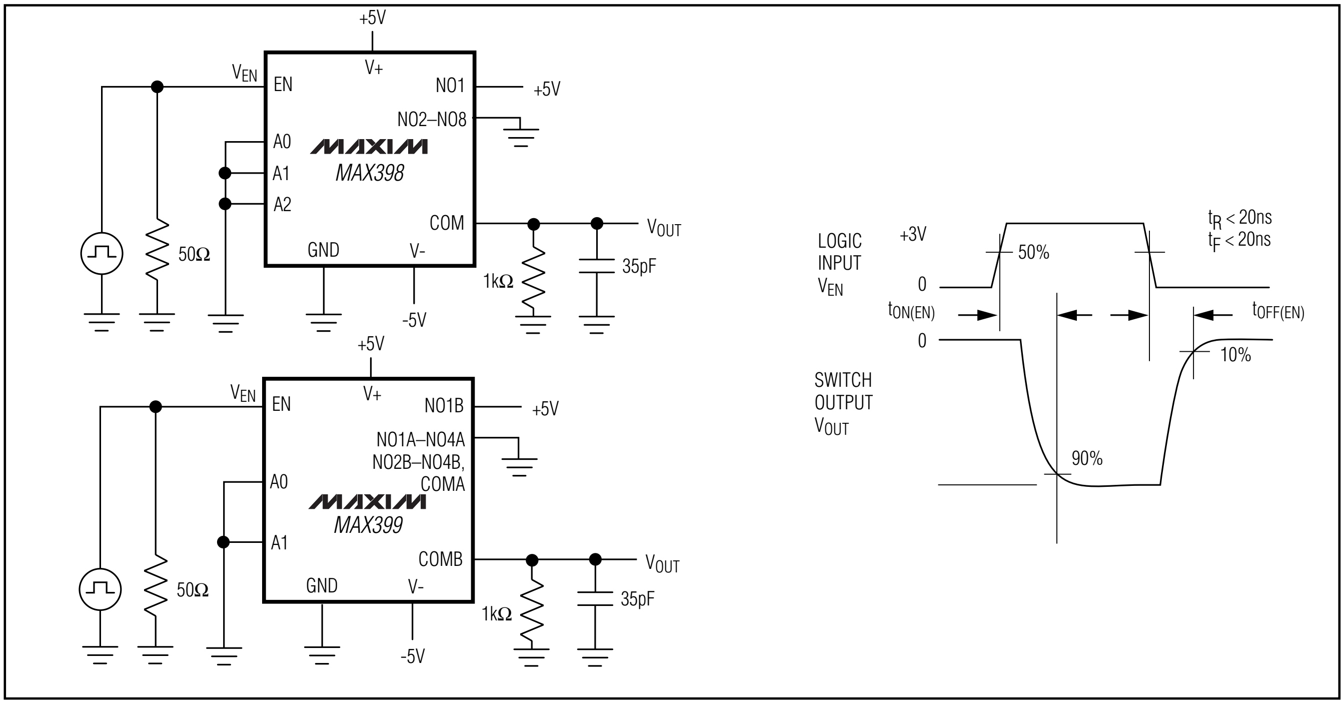


Figure 3. Enable Switching Time

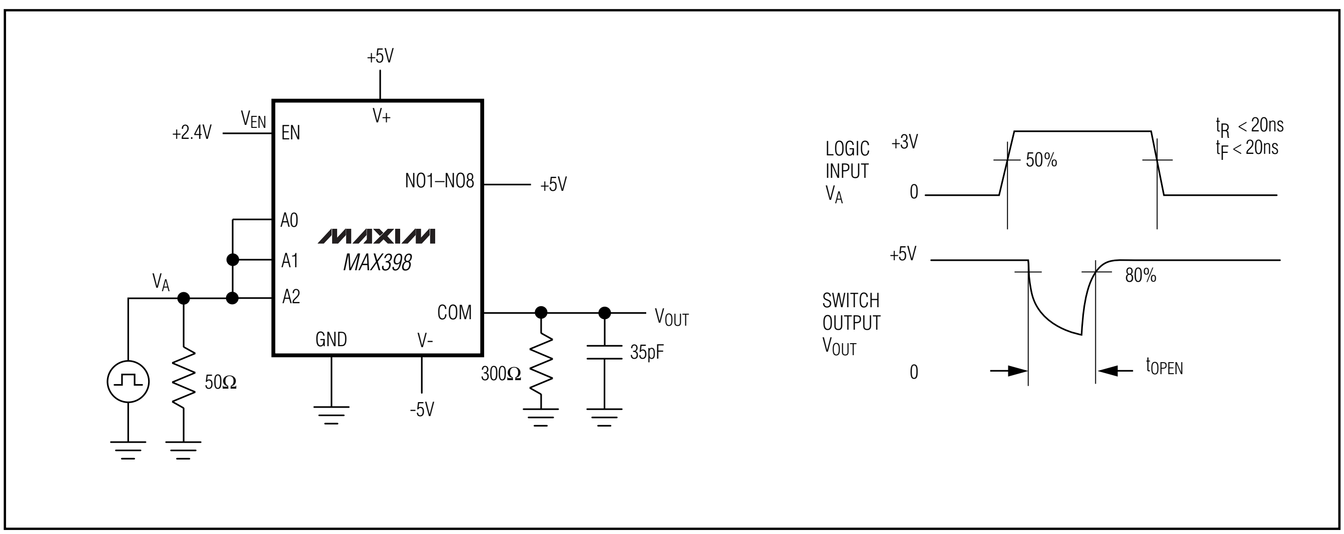


Figure 4. Break-Before-Make Interval

Test Circuits/Timing Diagrams (continued)

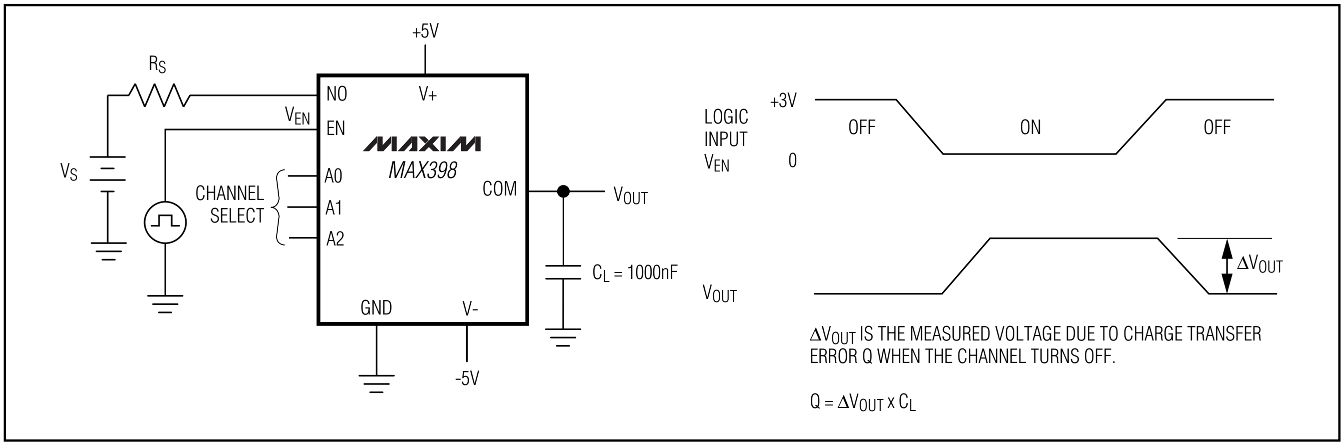


Figure 5. Charge Injection

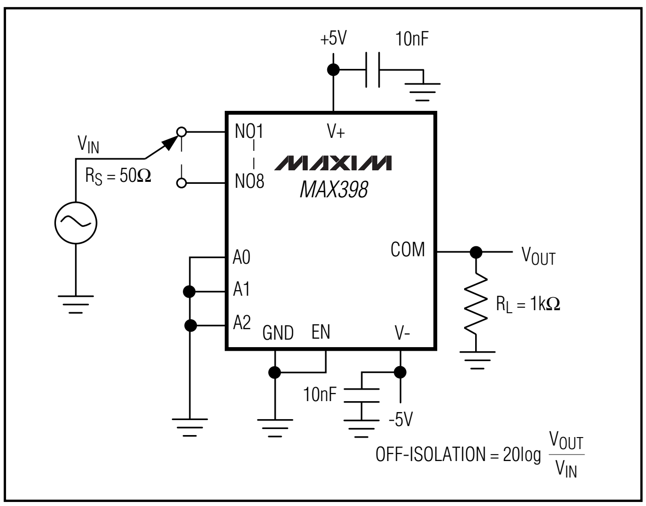


Figure 6. Off-Isolation

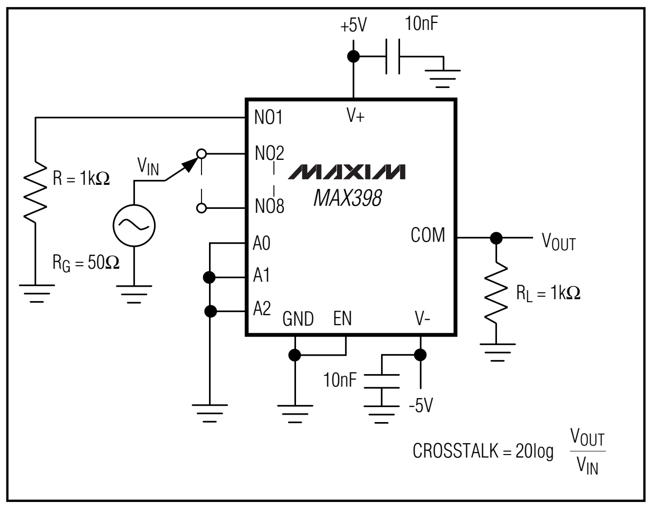


Figure 7. Crosstalk

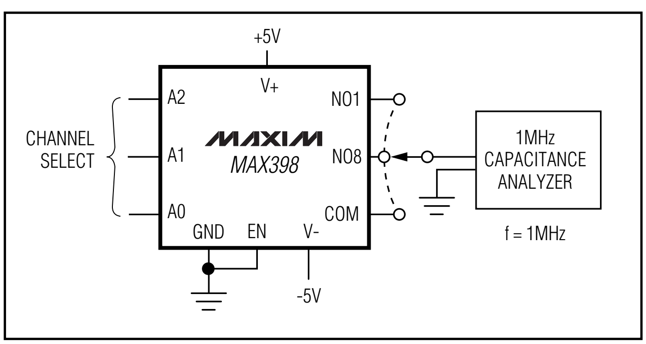
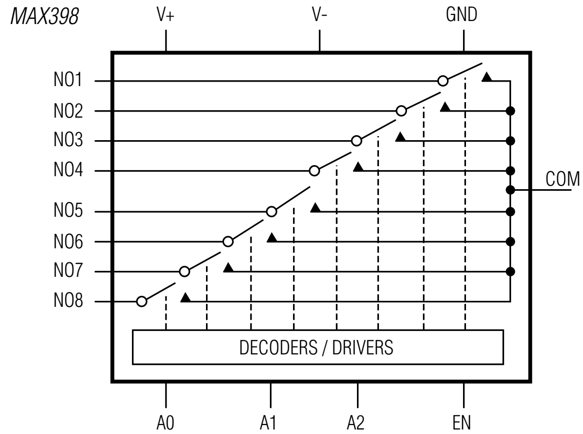
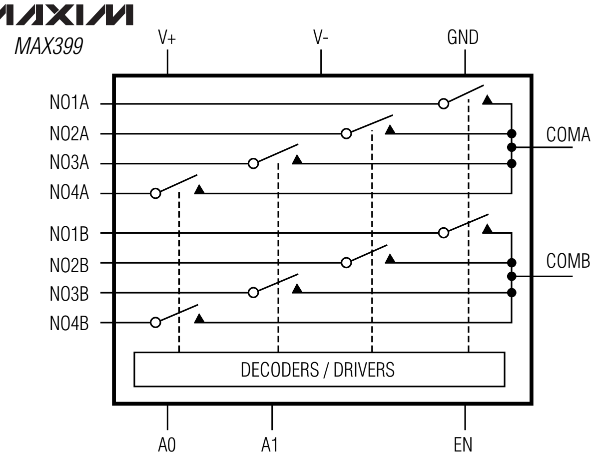


Figure 8. NO/COM Capacitance

Functional Diagrams/Truth Tables





MAX398				
A2	**A1**	**A0**	**EN**	**ON SWITCH**
X	X	X	0	NONE
0	0	0	1	1
0	0	1	1	2
0	1	0	1	3
0	1	1	1	4
1	0	0	1	5
1	0	1	1	6
1	1	0	1	7
1	1	1	1	8

MAX399			
A1	**A0**	**EN**	**ON SWITCH**
X	X	0	NONE
0	0	1	1
0	1	1	2
1	0	1	3
1	1	1	4

LOGIC "0" $V_{AL} \leq +0.8$ V, LOGIC "1" $V_{AH} \geq +2.4$ V

Precision, 8-Channel/Dual 4-Channel, Low-Voltage, CMOS Analog Multiplexers

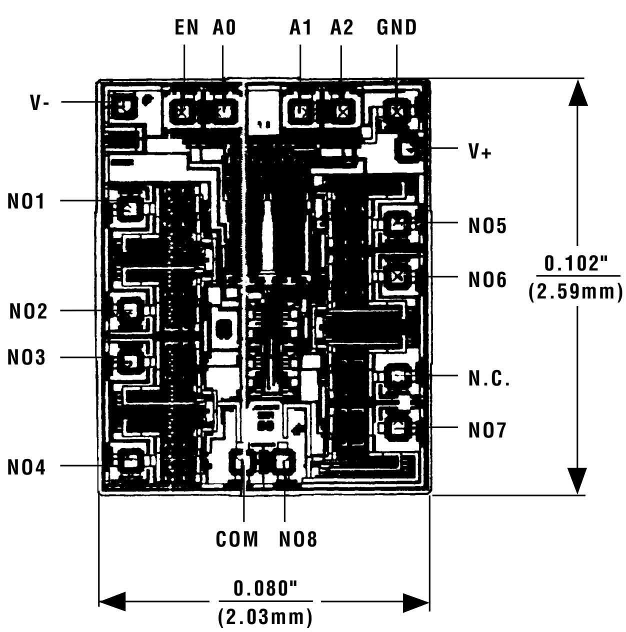
Ordering Information (continued)

PART	TEMP RANGE	PIN-PACKAGE	PKG CODE
MAX399CGE	0°C to +70°C	16 QFN-EP*	G1655-3
MAX399CEE	0°C to +70°C	16 QSOP	E16-1
MAX399CSE	0°C to +70°C	16 Narrow	S16-1
MAX399CPE	0°C to +70°C	16 Plastic	P16-1
MAX399C/D	0°C to +70°C	Dice**	—
MAX399EGE	-40°C to + 85°C	16 QFN-EP*	G1655-3
MAX399EEE	-40°C to + 85°C	16 QSOP	E16-1
MAX399ESE	-40°C to + 85°C	16 Narrow	S16-1
MAX399EPE	-40°C to + 85°C	16 Plastic	P16-1
MAX399EJE	-40°C to + 85°C	16 CERDIP†	J16-1
MAX399MJE	-55°C to +125°C	16 CERDIP†	J16-1

**EP = Exposed pad.*
***Contact factory for dice specifications.*
†Contact factory for package availability.

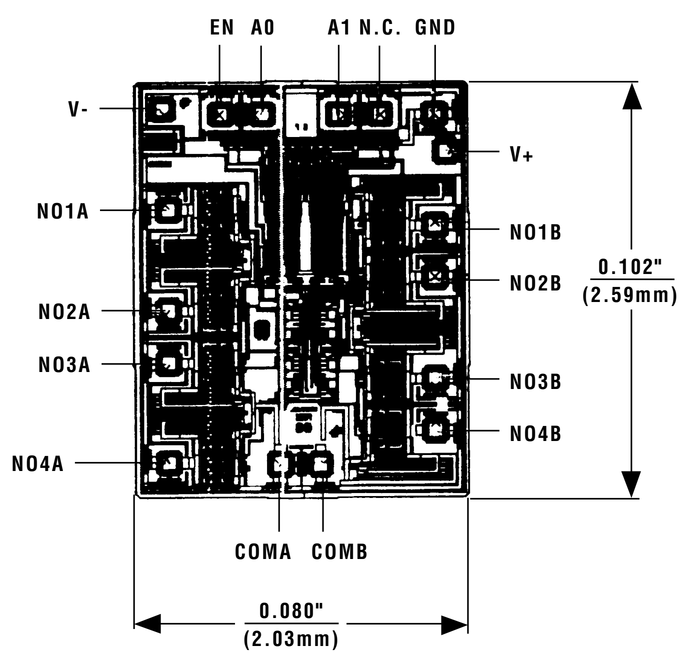
Chip Topographies

MAX398



TRANSISTOR COUNT: 161
SUBSTRATE CONNECTED TO V+

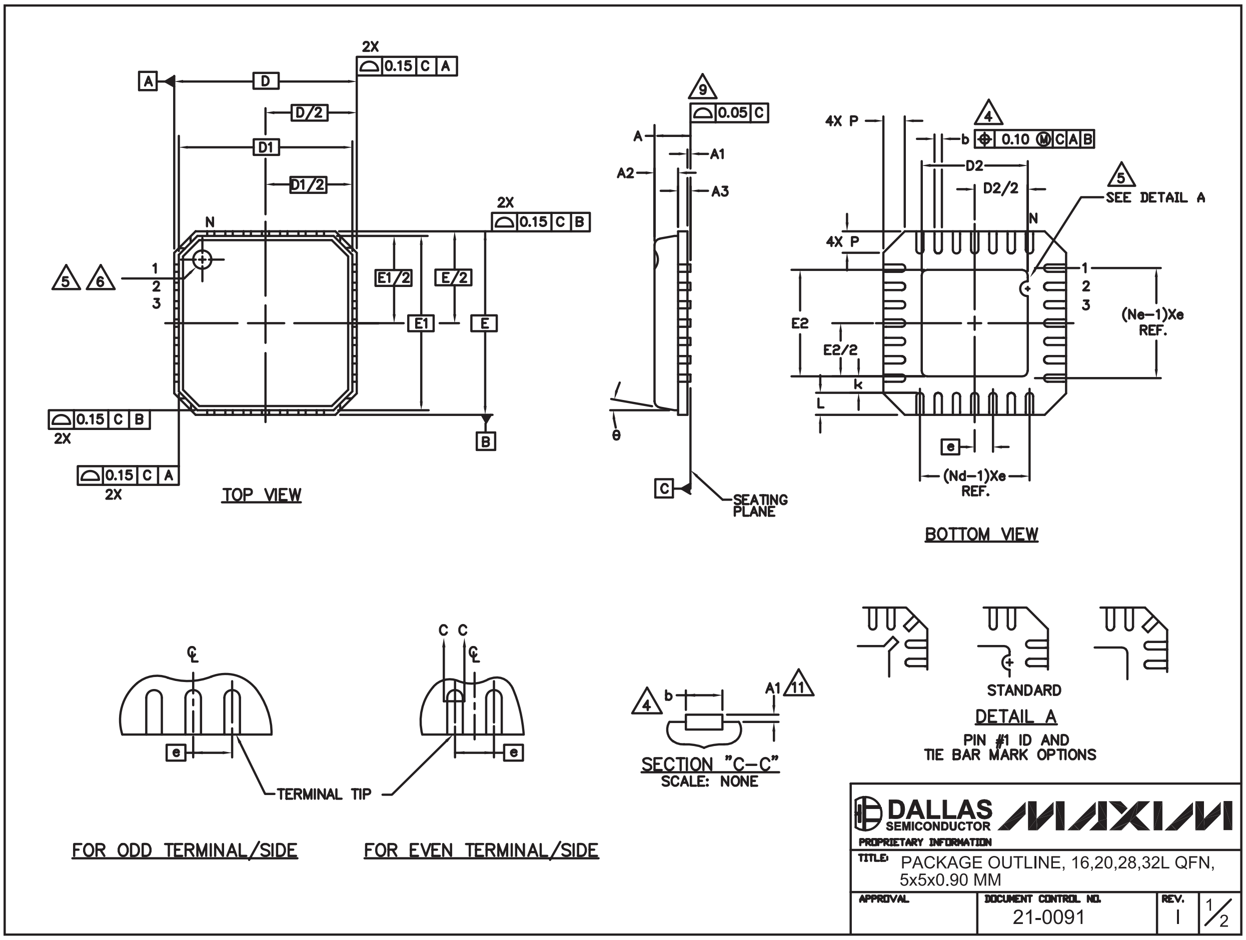
MAX399



TRANSISTOR COUNT: 161
SUBSTRATE CONNECTED TO V+

Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)



Precision, 8-Channel/Dual 4-Channel, Low-Voltage, CMOS Analog Multiplexers

Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

COMMON DIMENSIONS

PKG	16L 5x5			20L 5x5			28L 5x5			32L 5x5		
SYMBOL	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00
A1	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05
A2	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00
A3	0.20 REF			0.20 REF			0.20 REF			0.20 REF		
b	0.28	0.33	0.40	0.23	0.28	0.35	0.18	0.23	0.30	0.18	0.23	0.30
D	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
D1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
E	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
E1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
e	0.80 BSC			0.65 BSC			0.50 BSC			0.50 BSC		
k	0.25	–	–	0.25	–	–	0.25	–	–	0.25	–	–
L	0.35	0.55	0.75	0.35	0.55	0.75	0.35	0.55	0.75	0.30	0.40	0.50
N	16			20			28			32		
ND	4			5			7			8		
NE	4			5			7			8		
P	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60
θ	0°		12°	0°		12°	0°		12°	0°		12°

EXPOSED PAD VARIATIONS

PKG. CODES	D2			E2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
G1655-3	2.95	3.10	3.25	2.95	3.10	3.25
G2055-1	2.55	2.70	2.85	2.55	2.70	2.85
G2055-2	2.95	3.10	3.25	2.95	3.10	3.25
G2855-1	2.55	2.70	2.85	2.55	2.70	2.85
G2855-2	2.95	3.10	3.25	2.95	3.10	3.25
G3255-1	2.95	3.10	3.25	2.95	3.10	3.25

NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. – 1994.
3. N IS THE NUMBER OF TERMINALS.
   Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION & Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED. DETAILS OF PIN #1 IDENTIFIER IS OPTIONAL, BUT MUST BE LOCATED WITHIN ZONE INDICATED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS.
   EXCLUDE EMBEDDED PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220; EXCEPT DIMENSION "b".
11. APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
12. THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES).

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

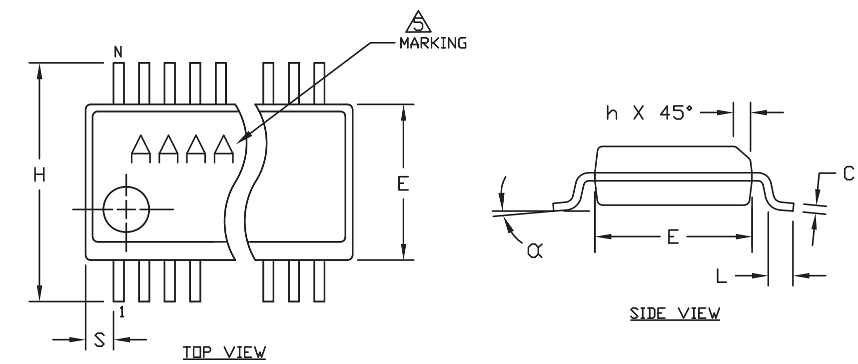
TITLE: PACKAGE OUTLINE, 16,20,28,32L QFN, 5x5x0.90 MM

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0091	I	2/2

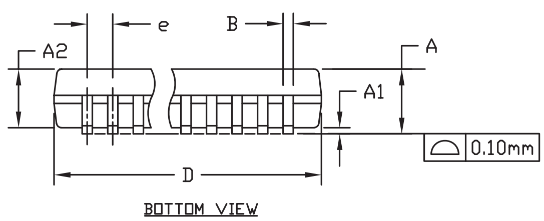
Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

QSOP.EPS



	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.053	.069	1.35	1.75
A1	.004	.010	.102	.254
A2	.049	.065	1.245	1.651
B	.008	.012	0.20	0.30
C	.0075	.0098	0.191	0.249
D	SEE VARIATIONS			
E	.150	.157	3.81	3.99
e	.025 BSC		0.635 BSC	
H	.230	.244	5.84	6.20
h	.010	.016	0.25	0.41
L	.016	.035	0.41	0.89
N	SEE VARIATIONS			
α	0°	8°	0°	8°



VARIATIONS:

	INCHES		MILLIMETERS			
	MIN.	MAX.	MIN.	MAX.	N	PKG CODES
D	.189	.196	4.80	4.98	16	E16-1, E16M-1, E16-3F, E16-4, E16-5, E16-6, E16-8F
S	.0020	.0070	0.05	0.18		
D	.337	.344	8.56	8.74	20	E20-1, E20-2
S	.0500	.0550	1.270	1.397		
D	.337	.344	8.56	8.74	24	E24-1, E24-2, E24-3F
S	.0250	.0300	0.635	0.762		
D	.386	.393	9.80	9.98	28	E28-1, E28M-1, E28-2
S	.0250	.0300	0.635	0.762		

NOTES:
1. D & E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .006" PER SIDE.
3. CONTROLLING DIMENSIONS: INCHES.
4. MEETS JEDEC MO137.
5. MARKING SHOWN IS FOR PKG. ORIENTATION ONLY.
6. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND PbFREE (+) PKG. CODES.

-DRAWING NOT TO SCALE-

MAXIM

TITLE: PACKAGE OUTLINE
QSOP .150", .025" LEAD PITCH

APPROVAL | DOCUMENT CONTROL NO. 21-0055 | REV. G | 1/1

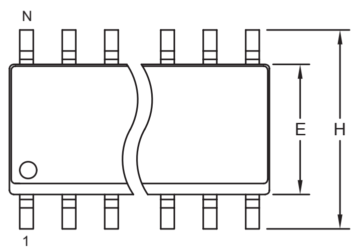
Precision, 8-Channel/Dual 4-Channel, Low-Voltage, CMOS Analog Multiplexers

Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

SOICN.EPS

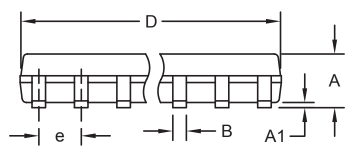
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050 BSC		1.27 BSC	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27



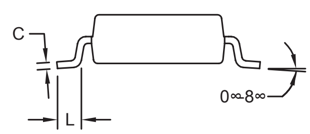
TOP VIEW

VARIATIONS:

	INCHES		MILLIMETERS			
DIM	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	AA
D	0.337	0.344	8.55	8.75	14	AB
D	0.386	0.394	9.80	10.00	16	AC



FRONT VIEW



SIDE VIEW

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. LEADS TO BE COPLANAR WITHIN 0.10mm (.004").
4. CONTROLLING DIMENSION: MILLIMETERS.
5. MEETS JEDEC MS012.
6. N = NUMBER OF PINS.

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

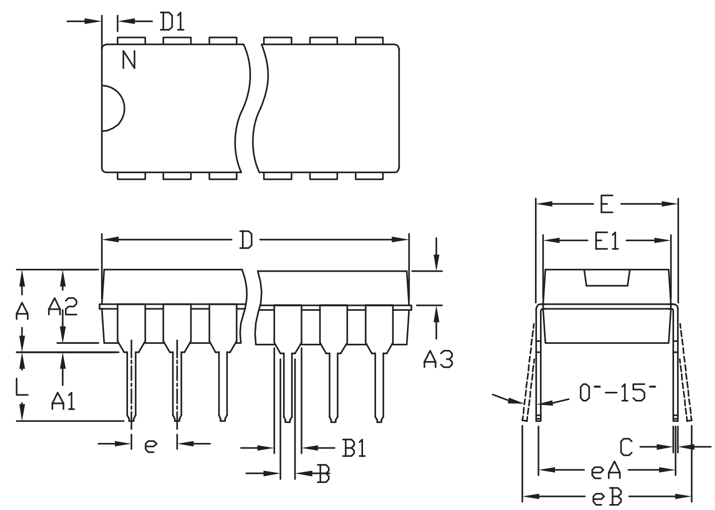
TITLE: PACKAGE OUTLINE, .150" SOIC

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0041	B	1/1

Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

PDIPN.EPS



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	---	0.180	---	4.572
A1	0.015	---	0.38	---
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.015	0.022	0.381	0.56
B1	0.045	0.065	1.14	1.65
C	0.008	0.014	0.2	0.355
D1	0.005	0.080	0.13	2.03
E	0.300	0.325	7.62	8.26
E1	0.240	0.310	6.10	7.87
e	0.100 BSC.		2.54 BSC.	
eA	0.300 BSC.		7.62 BSC.	
eB	0.400 BSC.		10.16 BSC.	
L	0.115	0.150	2.921	3.81

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS001
D	0.348	0.390	8.84	9.91	8	AB
D	0.735	0.765	18.67	19.43	14	AC
D	0.745	0.765	18.92	19.43	16	AA
D	0.885	0.915	22.48	23.24	18	AD
D	1.015	1.045	25.78	26.54	20	AE
D	1.14	1.265	28.96	32.13	24	AF
D	1.360	1.380	34.54	35.05	28	*5

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC MS001-XX AS SHOWN IN ABOVE TABLE
5. SIMILIAR TO JEDEC MO-058AB
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR. SUNNYVALE CA 94086 FAX (408) 737 7194
PROPRIETARY INFORMATION

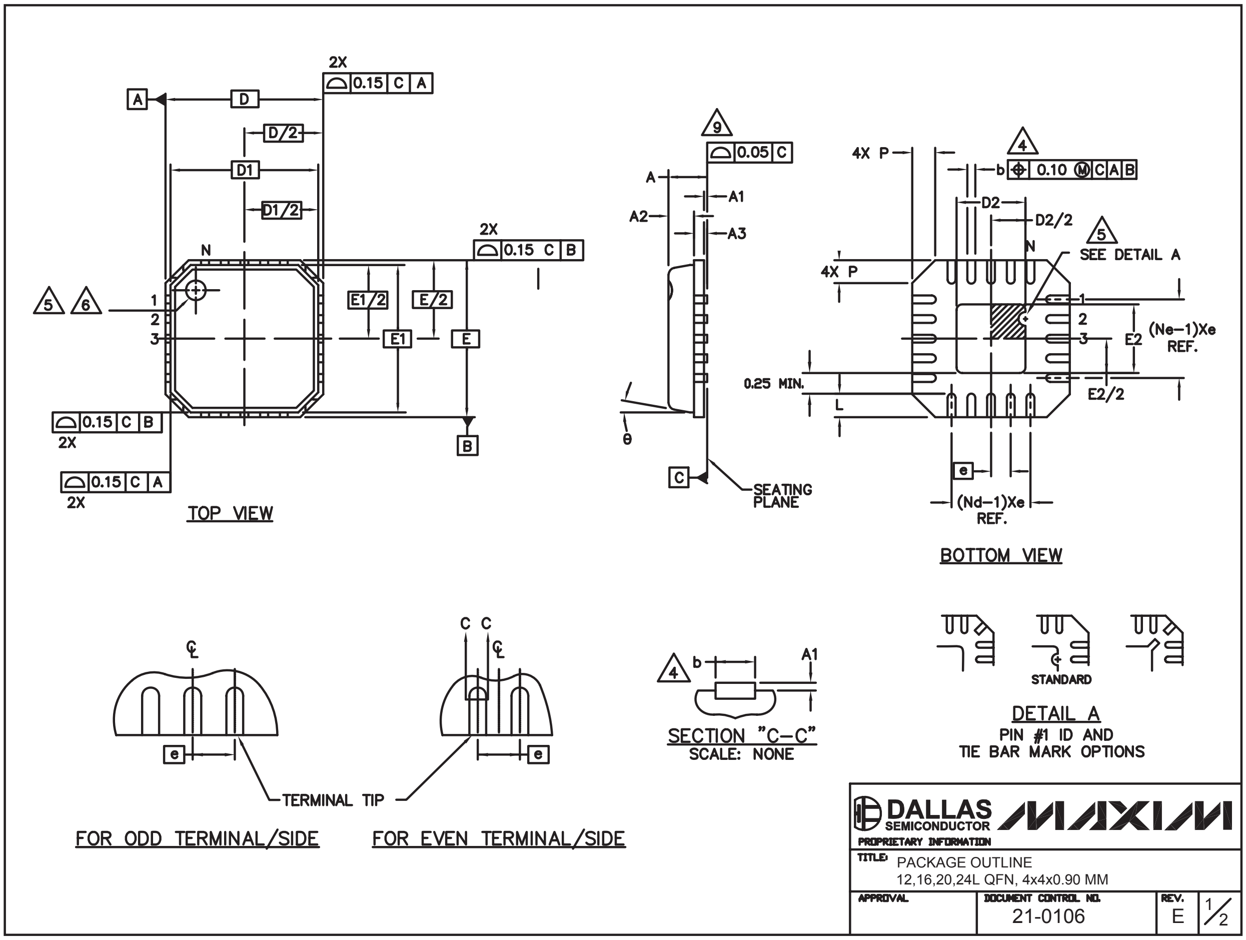
TITLE: PACKAGE FAMILY OUTLINE: PDIP .300" 1/1

DOCUMENT CONTROL NUMBER: 21-0043 REV: D

Precision, 8-Channel/Dual 4-Channel, Low-Voltage, CMOS Analog Multiplexers

Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)



12,16,20, 24L QFN.EPS

Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM).
2. DIMENSIONING & TOLERANCES CONFORM MUST TO ASME Y14.5M. – 1994.
3. N IS THE NUMBER OF TERMINALS.
   Nd IS THE NUMBER OF TERMINALS IN X–DIRECTION &
   Ne IS THE NUMBER OF TERMINALS IN Y–DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED. DETAILS OF PIN #1 IDENTIFIER IS OPTIONAL, BUT MUST BE LOCATED WITHIN ZONE INDICATED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS.
   EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220; EXCEPT DIMENSION "b".
11. THIS PACKAGE OUTLINE APPLIES TO PUNCHED QFN (STEPPED SIDES).

SYMBOL	COMMON DIMENSIONS			NOTE
	MIN.	NOM.	MAX.	
A	0.80	0.90	1.00	
A1	0.00	0.01	0.05	
A2	0.00	0.65	0.80	
A3		0.20 REF.		
D		4.00 BSC		
D1		3.75 BSC		
E		4.00 BSC		
E1		3.75 BSC		
θ	0°	–	12°	
P	0.24	0.42	0.60	

SYMBOL	PITCH VARIATION A			NOTE
	MIN.	NOM.	MAX.	
e		0.80 BSC		
N		12		3
Nd		3		3
Ne		3		3
L	0.50	0.60	0.75	
b	0.28	0.33	0.40	4

SYMBOL	PITCH VARIATION B			NOTE
	MIN.	NOM.	MAX.	
e		0.65 BSC		
N		16		3
Nd		4		3
Ne		4		3
L	0.50	0.60	0.75	
b	0.23	0.28	0.35	4

SYMBOL	PITCH VARIATION C			NOTE
	MIN.	NOM.	MAX.	
e		0.50 BSC		
N		20		3
Nd		5		3
Ne		5		3
L	0.50	0.60	0.75	
b	0.18	0.23	0.30	4

SYMBOL	PITCH VARIATION D			NOTE
	MIN.	NOM.	MAX.	
e		0.50 BSC		
N		24		3
Nd		6		3
Ne		6		3
L	0.30	0.40	0.50	
b	0.18	0.23	0.30	4

PKG. CODE	EXPOSED PAD VARIATION D2			E2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
G1244–2	1.95	2.10	2.25	1.95	2.10	2.25
G1644–1	1.95	2.10	2.25	1.95	2.10	2.25
G2044–3	1.95	2.10	2.25	1.95	2.10	2.25
G2044–4	1.55	1.70	1.85	1.55	1.70	1.85
G2444–1	1.95	2.10	2.25	1.95	2.10	2.25

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE
12,16,20,24L QFN, 4x4x0.90 MM

APPROVAL | DOCUMENT CONTROL NO. 21-0106 | REV. E | 2/2

Precision, 8-Channel/Dual 4-Channel, Low-Voltage, CMOS Analog Multiplexers

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/94	–	—
1	9/94	Initial release of data sheet	–
2	7/95	–	–
3	7/96	–	–
4	5/99	Errors in commercial data	–
5	6/99	Add QSOP Package	–
6	10/01	Add QFN Package	–
7	1/07	Add Exposed Pad info for QFN	–
8	6/07	Exposed pad designation	1, 7, 12